Plant Diseases in Ecosystems: threats and impacts in south-western Australia

Symposium Summary

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This symposium reflected the levels of awareness, competence and action focussed upon the problems of plant diseases in Western Australian ecosystems. The problem of *Phytophthora cinnamomi*, the major pathogen in our plant communities, has been likened to a massive invasion[2]. While it is unlikely that the invader will ever be routed, this symposium may help in formulating appropriate strategic and tactical responses to impede its progress and minimise its destructive effects.

Peter Bridgewater[1] outlined the Commonwealth Government's legislative interest in and financial support of dieback research. He emphasised that disease in plant ecosystems was a problem affecting a large proportion of the Australian continent and that the diseases were permanently altering ecosystems, eliminating many keystone species and leaving behind a considerably less diverse community of resistant survivors. In the south-west land division of Western Australia some 1500 to 2000 of the approximately 9000 extant species were susceptible to *P. cinnamomi*, the major pathogen causing dieback disease, but a number of additional pathogens were involved. The reason why such a large proportion of the native flora was susceptible to dieback diseases was a question still not properly answered. The point was made that research and management practices should beware of concentrating upon the curing of symptoms rather than attacking the disease. This puts in sharp focus the possibility that plant diseases in ecosystems may well be a symptom of a more deeply seated ecological malaise. The basic malaise is obviously human involvement in ecosystem dynamics, both direct and indirect, and the minimisation and rectification of the damage resulting from plant diseases in natural ecosystems must clearly involve land management procedures.

Frank Podger[2] likens the advance of *P. cinnamomi* in our plant communities to an invasion and considers it essentially unstoppable so that it will ultimately infect and affect all the available population systems within the continent. He attributes the entry and the primary spread of the disease directly and unequivocally to the activity of man, but is optimistic about our ability to slow its progress.

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Bryan Shearer[3] outlined the taxonomic constitution, distribution and impact of four classes of disease producing fungal pathogens in native plant communities in south-western Australia. As well as *Phytophthora*, of which *P. cinnamomi* is the most destructive, *Armillaria leutobubalina* is a very important rootrot fungus which possibly has a wider host range than *Phytophthora*. There is a variety of stem canker fungi and rusts. *Armillaria*, the stem cankers and rusts are probably endemic fungi normally with restricted impacts, but are they becoming increasingly important as hitherto undefined ecological balances become perturbed. Expanded taxonomic research and an inventory of disease incidence is required to document the importance of these pathogens, as well as that due to *Phytophthora*.

Elaine Davison[4] provided evidence strongly suggesting that dieback symptoms and death may be induced in jarrah as a consequence of waterlogging, even without *P. cinnamomi* infection. However, the waterlogged conditions may promote pathogen activity, and secondarily result in increased levels of infection. This is indeed a situation where symptoms and disease may be easily confused.

Ray Wills and Greg Keighery[5] reported that 38% of 460 plant taxa examined are susceptible to *P. cinnamomi*, while 59% of 436 taxa were sensitive to canker fungi. Some 86% of Proteaceae species are susceptible to these pathogens, and after infection the percentage cover of dominant Proteaceous species may be reduced by 95%. The species removed are often keystone species, providing food, cover and nesting resources for associated animals[7] and altering the light regimes necessary to support erstwhile associated plants. Removal of the dominant species by *P. cinnamomi* and canker disease leaves a simpler, less diverse community dominated by rushes and sedges. While these remnants are resistance to *P. cinnamomi* and canker diseases, they are susceptible to a suite of smuts and rootrots[6], and the subsequent performance of these residual populations is conjectural.

While the effect of plant diseases in the loss of diversity and structure of complex plant communities is quite striking, it may not be recognised as such by an untrained observer. Nick Malajczuk and Martin Pearce[8] emphasised that the changes induced in the soil microflora and microfauna may be equally or even more dramatic. He pointed out that the taxonomic complexity of the soil microorganisms is orders of magnitude greater than that of the above ground

vascular plants, and that some 50% of the energy captured by plant photosynthesis finds its way into maintaining the rhizosphere. We are only beginning to chart the dynamics of rhizosphere ecology.

Stuart Crombie outlined the difficulties in assessing the effects of plant disease on timber production in local forests[9]. The Western Australian forests currently produce some 2 x $10^6 m^3$ timber per annum, from which the state receives about $100 million. In addition, the forests have value in water catchment, tourism and education. The effects of timber harvesting on the spread of disease, however, is pronounced, with the major outbreaks of *P. cinnamomi* being closely associated with logging activities, especially the establishment of road networks throughout the forests[2]. Much of the expense associated with timber harvesting is presently concerned with the implementation of disease minimisation.

Ian Colquhoun and Anthony Petersen outlined the dieback control and environmental restoration measures adopted by Alcoa of Australia and RGC Mineral Sands Ltd[11]. Dieback control is a source of additional costs in both industries, but probably represent less than 0.5% of the value of the industries per year.

Industries dependent upon the products of natural plant communities and the threats posed by plant diseases were outlined by Chris Robinson and Ray Wills[10]. Minor industries include honey production ($2 million *per annum*) and cut flowers ($18 million *per annum*). Both these industries are severely affected by plant diseases, but both may ultimately become based on cultivated native plant farms. The tourism industry in Western Australia is a major source of wealth, ($3 billion *per annum*), but only an indeterminate fraction of this industry can be attributed to the attraction of our native plant communities and it is not clear that any changes wrought by plant diseases have diminished that attraction.

Kelly Gillen and Anna Napier[12] reviewed the management of access for recreational activities in the control of dieback diseases in native plant communities. Public access is clearly critical in the spread of dieback. The severe impact of *P. cinnamomi* on almost 75% of the Stirling Range National Park demonstrates the effect of facilitating recreational use in spreading disease. Management of access requires considerable resources in planning and providing appropriate surfaces and drainage patterns, the implementation of seasonal or permanent closure, and the provision of washdown facilities.

Giles Hardy *et al.* reviewed a wide variety of techniques now available for the detection and control of plant pathogens in native plant communities[13], and Jen McComb *et al.* showed that the breeding and cloning of native plants resistant to some pathogens is possible[14]. However, the costs of implementing these "solutions", the large number of imperilled species and the extensive area of infection necessitates a system of prioritisation. Some targeted species and some targeted communities may be protectable at substantial costs.

Greg Keighery *et al.* showed that almost every human activity in and near native plant communities is likely to create an ecological imbalance and to promote the spread of disease[15]. Ecosystem changes wrought by the diseases, especially in association with land clearing and a new set of grazers, predators, pollinators and weed competitors, is permanent. Joanna Young suggested that disease spread and the threat to our flora and its associated fauna may be reduced by land management practices which take basic ecological principles into account[16]. It is, however, arguable that many of the pertinent ecological principles are not yet known or are inimical to our society's requirements.

References

[from Handbook of the Symposium on Plant Diseases in Ecosystems: threats and impacts in south-western Australia, 1994. Eds R T Wills & W A Cowling. Royal Society of Western Australia and Ecological Society of Australia, Perth.]

1 Opening Address: P Bridgewater

2 History of Research: F D Podger

3 Major plant pathogens in ecosystems: B L Shearer

4 Role of environment in dieback of jarrah: E Davison

5 Impact of plant disease on plant ecology: R T Wills & G J Keighery

6 Smut and root rots on native rushes and sedges: K A Websdane, I M Sieler, K Sivasithamparam & K W Dixon

7 Impact of plant disease on animal ecology: B A Wilson, G Newell, W S Laidlaw & G Friend

8 Impact of plant disease on microbial ecology: N Malaczuk & M H Pearce

9 Disease and forest production in WA: D S Crombie

10 Threats of plant disease to flora-based industries; C J Robinson & R T Wills

11 The impact of plant disease on mining: I J Colquhoun & A E Petersen

12 Management of access: K Gillen & A Napier

13 Control options of plant pathogens in native plant communities in south-western Australia: G E St J Hardy, P A O'Brien & B L Shearer

14 Future ecosystems - use of genetic resistance: J A McComb, M Stukely & I Bennett

15 Future ecosystems - ecological balance: G J Keighery, N Gibson & D J Coates

16 Future ecosystems - effects of plant disease on Society: J T Young